GENERAL BOARD OF HEALTH.

REPORT

ON THE

SUPPLY OF WATER

TO

THE METROPOLIS.

APPENDIX No. IV.

THE CESSPOOL SYSTEM IN PARIS.

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REPORT

ON

THE CESSPOOL SYSTEM IN PARIS,

By Thomas W. Rammell, Esq., C.E.

Mr. Rammell.

The following account of the system adopted in Paris for the disposal of the refuse matter of the inhabitants was drawn up after some inquiries on the subject made during a visit to that city in the months of April and May 1848.

These inquiries were only incidentally undertaken, at the request of the Metropolitan Sanitary Commissioners; and from circumstances were necessarily of a somewhat general character, and directed chiefly to the more prominent features of the subject: the account, therefore, cannot pretend either to great minuteness of detail, or fulness of exposition. Through letters of introduction, however, obligingly furnished by Mr. Chadwick, and the kind intervention of Mr. J. F. Clark, of the English Embassy, access was obtained to authentic sources of information, from which the writer was enabled to collect some important facts. These, it is hoped, being new, or not generally known in this country, will impart to the paper a degree of interest.

It is the practice in Paris to dispose of all the kitchen and dry refuse by depositing it in the streets at midnight, whence it is removed at dawn and during the early morning hours by the scavengers. In the meantime, however, the heaps are carefully turned over by the *chiffoniers*, a numerous class, to whom all sorts of odds and ends, such as bones, bits of bread, rags, old pots, broken bottles, &c., &c., have a marketable value.

The greater portion of the liquid refuse, including water which has been used in culinary or cleansing processes, is got rid of by means of open channels laid across the court-yards and the foot pavements to the street gutters, along which it flows until it falls through the nearest gully into the sewers, and ultimately into the Seine. If produced in the upper part of a house, this description of refuse is first poured into an external shoot branching out of the rainwater pipe, with one of which every floor is usually provided. Iron pipes have been lately much introduced in place of the open channels across the foot pavements; these are laid level with the surface, and are cast with an open slit about one inch in width at the top to afford facility for cleansing them. During the busy parts of the day there are constant streams of such fluids running through most of the streets of Paris, the smell arising from which is by no means agreeable. In hot weather it is the practice to turn on the public stand-pipes for an hour or two to dilute the matter and accelerate its flow.

With respect to fæcal refuse, and much of the house slops, particularly those of bed-chambers, the cesspool is universally adopted in Paris as the immediate receptacle. The cesspools are of two sorts: 1. Fixed or excavated cesspools; 2. Moveable cesspools.

In early times the excavated cesspools or pits, were constructed in the rudest manner, and cleaned out more or less frequently, or utterly

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neglected at the discretion of their owners. As the city increased in size, however, and as the permeations necessarily taking place into the soil accumulated in the lapse of centuries, the evil resulting was found to be of grave magnitude, calling for prompt and vigorous interference on the part of the authorities. It appears certain that prior to the year 1819, (when a strict *ordonnance* was issued on the subject,) the cesspools were very carelessly constructed. For the most part they were far from water-tight, and very probably were generally intended to be so. Consequently, nearly the whole of the fluid matter passed into them drained into the springs beneath the substratum, or became absorbed by the surrounding soil. Not only this, the basement walls of the houses became saturated with these offensive permeations, and the atmosphere, more particularly in the interior of the dwellings, tainted with their exhalations.

The moveable cesspools, for the most part, consist simply of tanks or barrels, which, when full, are removed to some convenient spot for the purpose of their contents being discharged. This form of cesspool, though not leading to the contamination of the soil naturally induced by the fixed or excavated cesspool, may occasion many offensive nuisances from carelessness in overfilling, or in the process of emptying.

It was with a view to protect the public health from the serious evils engendered by a reckless process of accumulation of fæcal matter that the *ordonnance* above referred to was issued on the 24th of September, 1819, laying down stringent regulations both as to the structure of cesspools fixed and moveable, and their mode of emptying. The execution of this *ordonnance* is entrusted to the Prefect of Police. The system established by it is evidently the fruit of a very careful study of the subject in all its details; and the regulations being very rigidly enforced, the cesspool system as carried out in Paris may be considered to be as perfect as the nature of the case will admit of. A description of it, therefore, however general, at the present time when public attention is so earnestly directed to everything that relates to the condition of our dwellings, may possibly not be entirely without value as a contribution to the stock of knowledge already collected on sanitary matters.

In the description which follows I propose to treat the subject under three principal heads, viz. :—

1. The construction of cesspools, fixed and moveable;
2. The modes of emptying them;
3. The places of deposit for the matter withdrawn; and the process of conversion of the soil into *poudrette*, by which it is fitted for uses to which it is ultimately applied;

And, in a concluding division, I shall consider the inconveniences which are found to be inseparably connected with the system even under the most perfect arrangements, and draw a comparison between the expense attaching to it and that which a system of tubular drainage would involve.

Construction of Cesspools.

1. *Fixed or Excavated Cesspools.*—The following are the principal provisions of the *ordonnance* of 1819, relating to the construction of the fixed or excavated cesspools; and as one of the articles ordained that "all cesspools existing at the date of this *ordonnance* shall be altered

in accordance with its provisions after the first subsequent emptying, or if that be found impracticable, shall be filled up;" the formulary so established, may be considered to represent the actual structure of all such cesspools in Paris. Mr. Rammell.

"The walls, the arch, and the bottom of the cesspool, shall be entirely constructed in '*pierres meulières*' (an exceedingly hard kind of stone), set in mortar, composed of hydraulic lime and clean river sand.

"The interior shall be plastered with mortar, made of the same materials.

"The arches shall not be less than from 12 to 14 inches (30 to 35 centimètres) in thickness, and the walls not less than from 18 to 20 inches (45 to 50 centimètres). The bottom shall be in the form of a basin, and the arch semicircular, or not varying from that form more than one third of the radius.

"All the angles of the interior shall be rounded to an arc whose radius shall not be less than 10 inches (25 centimètres). (The object of this regulation was to prevent the free evolution of gases, which acute angles had been found to favour.)

"The cesspools shall be on the plan, circular, elliptical, or rectangular, wherever the localities will allow the adoption of either of these forms. Acute angular forms will not be permitted, unless the area of the cesspool shall be at least 4 square mètres on each side of the angle, and then two man-holes shall be formed.

"No cesspool shall have a less interior height than 6 feet 6 inches (2 mètres) in the clear.

"The man-hole shall be placed near the middle; it shall not be less than 3 feet 3 inches long, by 2 feet $1\frac{1}{2}$ inches wide (1 mètre by 65 centimètres), and its depth to the crown of the arch ought not to be more than 4 feet $10\frac{1}{2}$ inches (1 mètre 50 centimètres). If the depth exceed this, the size of the opening must be increased in proportion.

"In addition to the man-hole, a hole, having a moveable stone cover, 1 foot $7\frac{1}{2}$ inches (50 centimètres) in diameter, with an iron ring in its centre, shall be formed in that part of the arch furthest from the soil-pipe, unless the man-hole opens on a ground floor having an untrapped closet.

"The soil-pipe shall always be placed in the middle; its interior diameter shall not be less than $9\frac{7}{8}$ inches (25 centimètres) if in pottery ware, and $7\frac{7}{8}$ inches (20 centimètres) if in cast iron. A vent-pipe, not less than $9\frac{7}{8}$ inches (25 centimètres) in diameter, shall be carried up to the level of the top of the chimneys of the house, or the chimneys of the adjoining houses, and neither of these pipes shall project into the cesspool beyond the line of the arch.

"When the cesspools are placed beneath cellars, such cellars must have a direct communication with the external air, and be large enough to contain four workmen with their tools, and they must be at least 6 feet 6 inches (2 mètres) high in the clear.

"No compartments or divisions shall be made nor detached pillars formed in the cesspools."

These provisions seem to embrace every point essential to the good construction of the cesspools: the form of this receptacle; the thickness of its walls and arches; the materials to be used in building it; the means of access to it; its ventilation: these points have all been

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well and judiciously considered by the authorities; and as the result, a very much more substantial and costly structure has been deemed proper for the temporary reception of fæcal matters in Paris than that in common use for the same purpose in this country.

A principal object of the *ordonnance* was to ensure the cesspools being thenceforth made water-tight; so that further pollution of the substratum and springs might be prevented; and the provisions for its attainment have been very strictly enforced by the police. The present cesspools are, in fact, water-tight constructions, retaining the whole of the liquids passed into them until the same are withdrawn by artificial means. The advantage has its attendant inconveniences, and moreover has been dearly paid for; for independently of the cost of the alterations and the increased cost of making the cesspools in the outset—the liquids no longer draining away by natural permeation—the constant expense of emptying them has enormously increased. In the better class of houses, where water is more freely used, whereas the cesspool was formerly emptied every eighteen months or two years, the operation has now to be repeated every three, four, or five months. An increased water supply has added to the evil; moderate even now as the extent of this supply is. Were the consumption equal to the demands of the English water-closet system, the expense and inconvenience would be increased to an intolerable degree.

The Parisian *cabinet* is not of a very perfect kind. The apparatus in common use consists of an earthenware basin communicating directly, or by a short branch, with the main soil pipe; the orifice being closed by a pan forming a very imperfect trap. In the inferior class of houses, the orifice of the basin is generally untrapped. Water is poured in from a pitcher in sufficient quantity to prevent complete obstruction; and to preserve a very moderate degree of cleanliness, the action of the liquid being occasionally assisted by the use of a long stick and a short stumpy broom, articles to be seen in almost every *cabinet*. The expense and labour of fetching the water, and the desire to avoid frequent emptyings of the cesspool, prevent its very copious use.

In the better description of houses there is usually at least one *cabinet* upon every floor, those of modern construction having one to every set of apartments. In houses of the inferior class, three, two, and sometimes one only, serve the wants of the whole of the inmates.

The section below exhibits the usual form of an excavated cesspool:—

The apparatus A B C is sometimes fixed in the cesspools to facilitate the process of extracting their contents. It consists of a pipe, generally of lead, B, about 4 inches (10 centimètres) in diameter, having a screw-cap, A,—by removing which the suction pipe of a pump may be connected,—and a small grated well, C, of cast iron to prevent the entrance of larger substances than will pass freely through the pipe. With this apparatus a cesspool may be emptied of everything, excepting large foreign substances, without opening the man-hole. A police regulation, however, directs that every time a cesspool is emptied it shall be opened for the purpose of ascertaining its state of repair, and this prevents any general adoption of the apparatus, as the only benefit now derived from it is the postponement of the operation of opening the cesspool until after the greater part of its contents have been withdrawn.

The usual capacity of the cesspools is from 10 to 12 cubic yards

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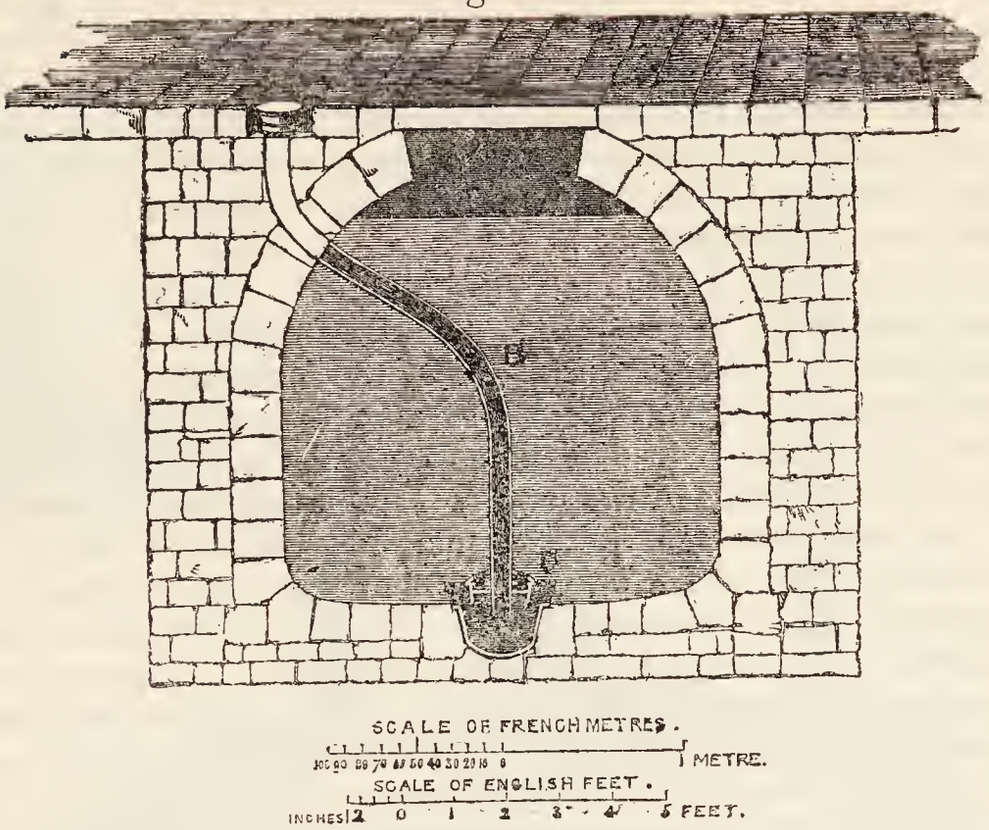
Fig. 1.



(8 to 10 cubic mètres), and the cost of one, built in accordance with the ordonnance, and of the usual size, cannot be estimated at less than 18*l.* sterling.

A house in Paris has frequently two or three of these cesspools, affording together space for the temporary reception of from 20 to 30 cubic yards of night-soil, placed, to suit local convenience, in different parts of the premises, sometimes under the house itself, sometimes under the courtyard. It must be borne in mind, however, that the houses in Paris are generally much larger than in London, so much so, indeed, that a single floor there may, without much exaggeration, be compared to an entire house here, it generally presenting sufficient accommodation for at least one family. Houses containing accommodation for 60 or 70 individuals are by no means rare, and the average number of inmates is very high; exceeding 24, according to the census of 1817.

This arrangement of the habitations has some bearing upon the question of drainage, for the communication between the several floors being vertical, not horizontal as between the houses here,—the solid matter produced on each can be passed with great facility, and with the aid of only a very small quantity of water, through a main soil-pipe, into one or more receptacles common to all. A certain amount of economy is the result.

The average degree of fluidity of the matter found in the excavated cesspools is what would be produced by the mixture of about one solid part with four of liquid; the solid (with the exception of foreign substances) consisting entirely of fæcal matter; and the liquid being composed of about three parts urine to five of water. It is estimated that, in the better class of houses, the daily quantity of matter, including the water necessary for cleanliness and to ensure the passage of the solids through the soil-pipe, passing into the cesspool from each individual amounts to $1\frac{3}{4}$ litres (3·08 English pints). Foreign substances are

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found in great abundance in the cesspools; the large soil-pipes permitting their easy introduction; so that the cesspool becomes the common receptacle for a great variety of articles that it is desired secretly to get rid of. Article 19 of the Police Regulations directs that nightmen finding any articles in the cesspools, especially such as lead to the suspicion of a crime or misdemeanor, shall make a declaration of the fact the same day to a Commissary of Police.

The cesspools vary considerably in foulness; and it is remarkable that those containing the greatest proportion of water are the most foul and dangerous. This is accounted for by the increased quantity of sulphuretted hydrogen gas evolved: and is more particularly the case where, from their large size, or from the small number of people using them, much time is allowed for the matter to stagnate and decompose in them. Soap-suds are said to add materially to their offensive and dangerous condition. The foulness of the cesspools, therefore, would appear to be in direct proportion to the cleanly habits of the inmates of the houses to which they respectively belong. Where urine predominates ammoniacal vapours are given off in considerable quantities, and although these affect the eyes of those exposed to them, and the nightmen suffer much from inflammation of these organs, no danger to life results. The inflammation, however, is often sufficiently acute to produce temporary blindness, and from this cause the men are at times thrown out of work for days together.

2. *Moveable Cesspools.*—There are two sorts of moveable cesspools; the one extremely simple and primitive in construction, the other more complicated. The former retains all the refuse, both liquid and solid, passed into it; the latter retains only the solid matter, the liquid being separated by a sort of strainer, and running off into another receptacle.

The advantage of this separating apparatus is that those cesspools provided with it require to be emptied less frequently than the others; the solid matter being alone retained in the moveable part. The liquid portion is withdrawn from the tank in which it is received by pumping.

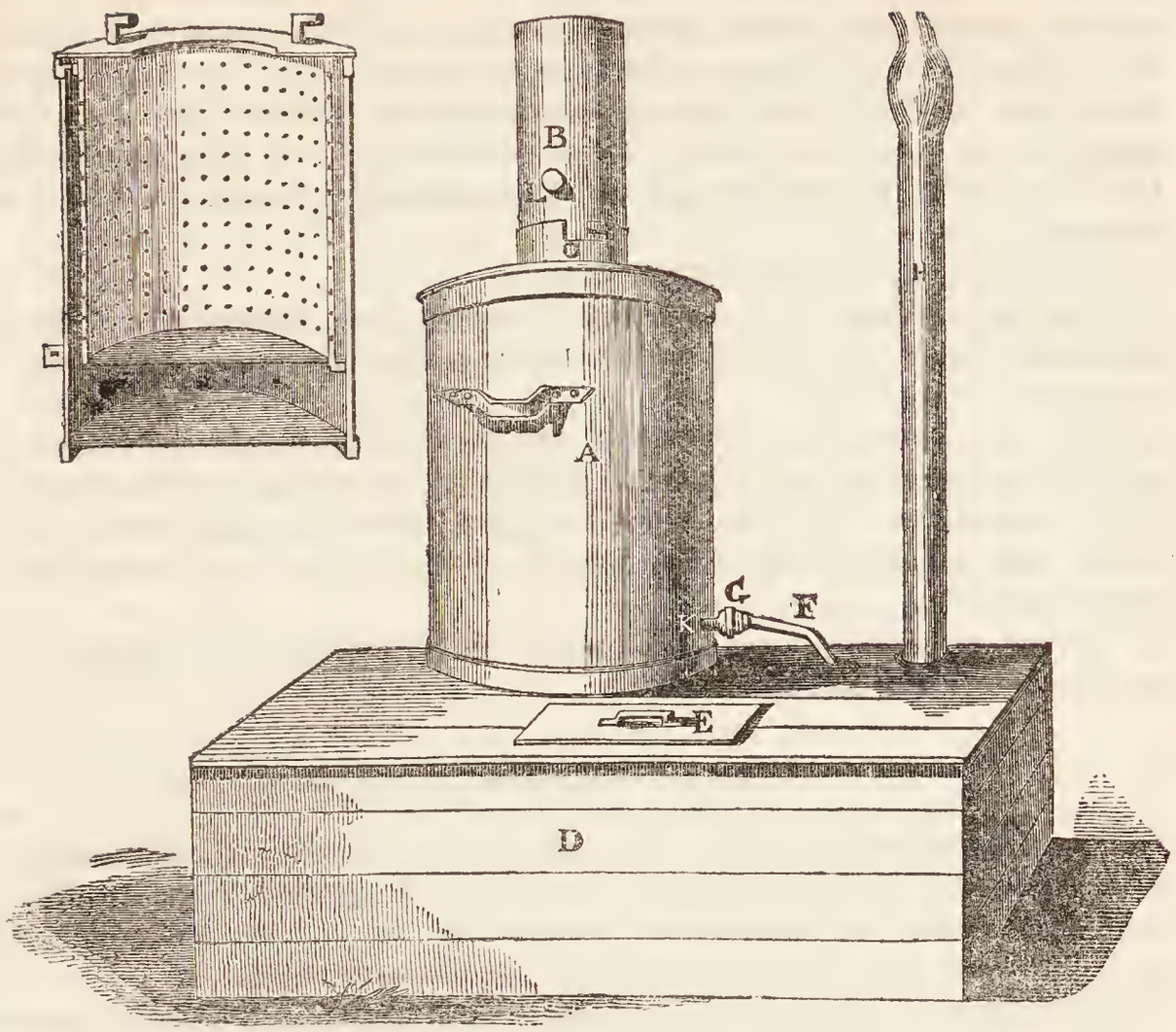
In the following illustration, Fig. 2 exhibits one of these cesspools, as it is usually fixed in the cellar or basement of a house, and Fig. 3 a section of the strainer or separating apparatus.

In Fig. 2, A is the moveable receptacle retaining the solid portion only of the matter which falls into it through the soil-pipe B. Its usual capacity is 55 gallons (250 litres). C is a loose muff of galvanized iron, connecting the soil-pipe with the dividing apparatus. D is a fixed tank or reservoir, constructed either of oak lined with lead or of rubble stone set in mortar, composed of hydraulic lime and clean river sand, and having its interior lined with Roman cement (sometimes a former cesspool is used for this reservoir). E is a man-hole. The capacity of this reservoir is generally about 880 gallons (4,000 litres).

Fig. 3 is a vertical section of the separating apparatus; it consists of two cylinders of zinc, differing in diameter about three centimètres, one fixed within the other. The surface of the inner cylinder is pierced with numerous small holes, so that it acts as a strainer, retaining the solid matter, and allowing the fluid to fall to the bottom of the outer cylinder, whence it is conducted by the pipe F into the reservoir D.

When the receptacle A is full, it is detached and removed in the following manner:

Fig. 3. Fig. 2.



The collar G is first unscrewed, the tube F detached, and a plug screwed into the socket K; the loose muff C is then lifted on to the pin L, a cover fitted into the opening in the top of the cylinder, and the receptacle A carried into a cart by a couple of men, an empty one being immediately substituted in its place.

The liquid matter contained in the reservoir D is removed by pumping into closed carts; the suction-pipe being attached to the fixed leaden pipe H, which, if the apparatus is placed in a cellar, is usually carried up into the yard. The pumps ordinarily used are worked by two men, and will fill a cart of the capacity of 2,000 litres in about 15 minutes.

The other kind of moveable cesspool consists simply of a wooden cask, set on end, and having its top pierced to admit the soil-pipe, which is connected in the manner before described. It is intended to retain both solid and liquid matter. When full, it is detached as in the former case, and the aperture in the top having been closed by a tight-fitting lid secured by an iron bar placed across, it is removed, and an empty one immediately substituted for it.

The moveable cesspool last described is much more generally used than the other kind; very few are furnished with the separating apparatus. But the use of either sort, I am told, is not on the increase. They are found, on the whole, to be more expensive than fixed cesspools, besides entailing many inconveniences, one of which is the frequent entrance of workmen upon the premises, for the purpose of removing them, which sometimes has to be done every second or third day. Moreover, if the

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cask becomes in the slightest degree overcharged, there is an overflow of matter when the soil-pipe is detached. On the other hand, if the removal takes place before the cask is completely filled, there is a waste of expense. Indeed the moveable system seems to be now only adopted where some difficulty had been found in altering the then existing fixed cesspools, in accordance with the *ordonnance* of the 24th September, 1819, or where it has been an object to avoid the first cost of a fixed cesspool.

The police regulations declare that —

"No apparatus of a moveable cesspool not approved of by the authorities shall be established in Paris for replacing cesspools in masonry.

"No apparatus of a moveable cesspool shall be fixed, without a previous declaration made at the prefecture of police by the owner, or by the contractor. A plan of the localities where the apparatus is to be placed, and a description of the means of ventilation shall be added to this declaration.

"Every apparatus when full shall be removed and replaced by another before the soil runs over."

II. The Mode of Emptying Cesspools.

The mode of emptying the cesspools is the next branch of the subject, and one which has exercised a good deal of ingenuity on the part of those who make a commercial speculation of it, besides constantly demanding the vigilant attention of the police authorities.

With regard to the moveable cesspool, the process of emptying is very simple, though undoubtedly demanding a considerable expenditure of labour. The tank or barrel, when filled, is, as before stated, disconnected from the soil-pipe, an empty one being immediately substituted in its place, and the bunghole being securely closed, it is conveyed away on a vehicle, somewhat resembling a brewer's dray (which holds about eight or ten of them), to the spot appointed as a depository of its discharged contents.

The removal of moveable cesspools is allowed to take place during the day.

Fixed or excavated cesspools, of course, require to be emptied on the spot into carts, which for the time answer the duty of moveable cesspools, insofar as relates to the purpose of transport. The process is necessarily attended, more or less, with stench and other disagreeable incidents to the annoyance of the inhabitants of the neighbourhood, and the passers by; and the police regulations, therefore, whilst providing every precaution which prudence could suggest as to the mode in which the process is conducted, require further that no cesspool shall be emptied, and no soil-cart employed in emptying it shall be allowed to go through the streets of Paris between the hours of eight in the morning and 10 in the evening from the 1st of October to the 31st of March; nor between the hours of six in the morning and 11 in the evening from the 1st of April to the 30th of September.

The proprietors of houses are required to empty their cesspools so soon as they are full, having previously given notice by a declaration in writing of their intention to do so. No cesspool may be partially

emptied without authority from the police. The soil must be thoroughly cleaned out, and then the cesspool swept and washed before it is again closed. No cesspool may be closed, after being emptied, without a written authority given, after inspection, by the Director of Public Health, or by the Commissary, architect of the *Petite Voirie.* Mr. Rammell.

The repairing of a cesspool is to be notified and performed with the same formalities and precautions as the emptying of one.

Before opening any cesspool, whether for the purpose of emptying or repair, precautions are taken to prevent accidents which might be produced by the escape or ignition of the gases which may have generated in them. The police regulations provide that no person shall be allowed to follow the business of nightman without having previously obtained a license or permission from the prefect of police, which is only granted after proof that the party is provided with the necessary apparatus, and carts for the extraction and transport of the soil, and also, with a suitable establishment or depôt in a certain locality, for their reception when not in use. The stock of the contractors for emptying night-soil is inspected at least twice a-year, when, if found inadequate, or out of repair, his license is withdrawn.

Other regulations provide that not less than four men shall form the "gang" employed in every case; that the soil shall not be removed from the cesspool until the carts have arrived; and that the carts, or apparatus, filled with night-soil, shall be removed direct to the depôts specified by the public authorities for its deposit.

Vidange Companies.—There are several companies in Paris—in all I believe eight—which undertake the extraction and removal of the contents of cesspools; they are termed *Compagnies de Vidanges.* That known as the *Compagnie Richer* is the most important of them, doing more than half the entire work. The capital invested in the working stock of this Company is, as I am informed, upwards of 200,000*l.* sterling. Their *service* requires, at the present rate of business, the labour of 350 horses, and the use of 120 vehicles of various descriptions. Their principal establishment is at Montfaucon, adjoining the *Voirie*, the spot upon which the night-soil of Paris has for ages been deposited. M. Heloin, the Managing Director of this Company, with much courtesy, gave me full explanations as to their mode of working; and as it does not differ in any material particular from that generally pursued, I shall confine myself, in the following details, to what I observed, or was informed of, in this establishment.

The mode of emptying the excavated or fixed cesspools adopted by this Company, and, indeed, universally in Paris, is to pump their contents into closed carts for transport. This operation is performed with two descriptions of pumps, one working on what may be called the hydraulic principle, the other on the pneumatic. In the former the valves are placed in the pipe communicating between the cesspool and the cart, and the matter itself is pumped. In the latter the valves are placed beyond the cart and the air being pumped out of the cart, the matter flows into it to fill up the vacuum so occasioned. The real principle is of course the same in both cases, the matter being forced up by atmospheric pressure. One advantage of the pneumatic system is, that there are no valves to impede the free passage of matter through the

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suction pipe; another, that it permits the use of a pipe of larger diameter.

The cart employed for the pneumatic system consists of an iron cylinder, mounted sometimes upon four, but generally upon two wheels, the latter arrangement being found to be the more convenient. Previous to use at the cesspool, the carts are drawn to a branch establishment, situated just within the Barrière du Combat, where they are exhausted of air with an air-pump worked by steam power. A 12-horse engine erected here is capable of exhausting five carts at the same time; the vacuum produced being equal to 28⅜ inches (72 centimètres) of mercury. A cart in good repair, and upon two wheels, will preserve a practical vacuum for 48 hours after exhaustion.

The usual capacity of both descriptions of cart is 2,000 litres, the largest size allowed by the police regulations, and the total weight, when full, about 3 tons 8 cwt. Three horses are employed to draw it.

Fig. 3.

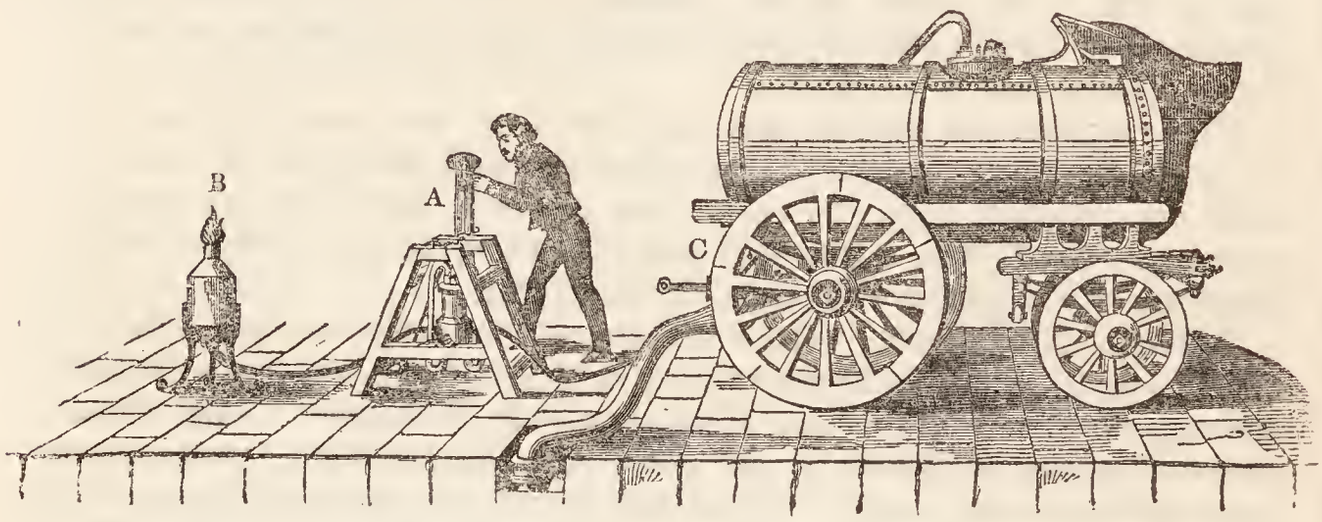


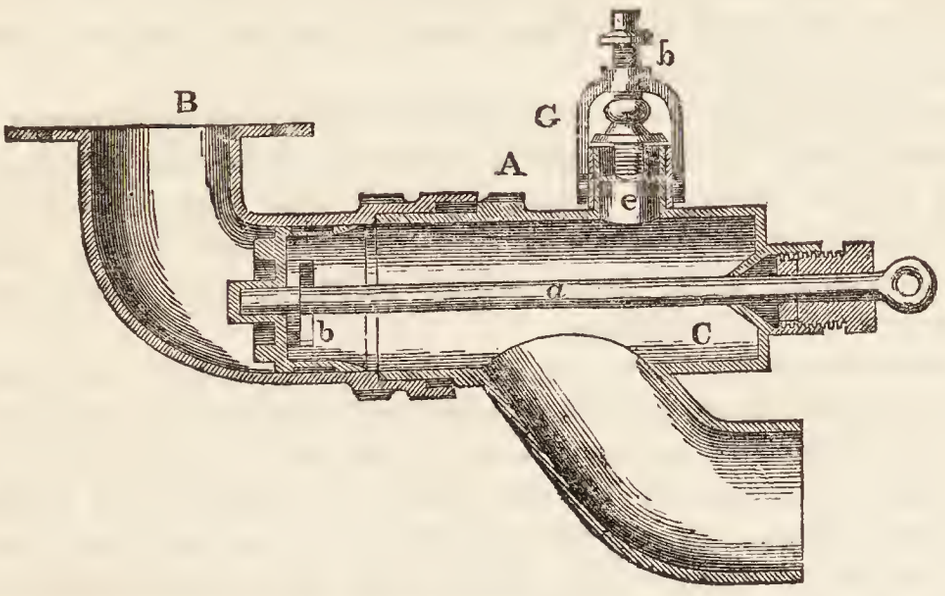
Fig. 3 represents one of the carts mounted upon four wheels, used for the pneumatic system, with a small air-pump for completing the exhaustion at the scene of operations shown at A, and a furnace for burning the foul air withdrawn, shown at B. The body of the cart is cylindrical, and is made of plates of wrought iron rivetted together.

The suction-pipe from the cesspool is connected by means of the piece C, which not only serves as the aperture for filling the cart, but also as the aperture for discharging its contents. It is shown on an enlarged scale in the drawing below, fig. 4, connected with the curved pipe B, which is usually fixed underneath the cart, near the end of the cylinder; sometimes this pipe is made to project horizontally from the end. The communication with the suction pipe, or the external air, is opened or closed by the plug *b*, which may be withdrawn from or inserted into the aperture by the rod *a*.

In order to save expense it was attempted to substitute wood for the iron used for the body of the cart, A very straight-grained wood was selected for the purpose, and subjected to some preparation. After the cylinder was formed, it was coated and lined with a composition, of which pitch was a principal ingredient. The attempt, however, was not successful, for, in use, it was found that the vacuum could not be maintained in these carts with certainty, in consequence

of the expansion and contraction of the material under the influence of atmospheric changes. Mr. Rammell.

Fig. 4.



The body of the cart used for the hydraulic system is formed of wood, strongly bound with iron hoops; and in shape resembles a butt. It holds, as the others, 2,000 litres, and is usually mounted, without springs, upon two wheels. The delivery pipe from the pump communicates at the top. The contents are discharged at the lower part behind.

The number of carts required for each operation, of course, varies according to the size of the cesspool to be emptied; but as these contain on the average about five cart-loads, that is the number usually sent.

In addition to the carts for the transport of the night-soil, a light-covered spring van drawn by one horse is used to carry the tools, &c. required in the process.

These consist of—

1. An air-pump when the work is to be done on the pneumatic system, and of a hydraulic pump when it is to be done on the hydraulic system.
2. About 50 mètres of suction-pipe of various forms and lengths.
3. A furnace for the purpose of burning the gases.
4. Wooden hods for the removal of the solid night-soil.
5. Pails, a ladder, pincers, levers, hammers, and other articles.

I shall now endeavour to describe the operation of filling the carts as performed upon the pneumatic system, with the machines and implements used for the purpose.

The carts belonging to the Compagnie Richer, are first taken to the establishment near the Barrière du Combat, where, as before stated, they are exhausted of air by steam power.

An opening into the cesspool having been effected, the suction-pipe is laid from this receptacle to the cart. This pipe is $3\frac{15}{16}$ inches (10 centimètres) in diameter, and is in separate pieces of about 10 feet each, with others shorter (down even to 1 foot), to make up any exact length required. Two kinds of it are commonly used; one made of leather, having iron wire wound spirally inside to prevent collapse, the other of copper.

The leather pipe is used where a certain degree of pliability is required; the copper for the straight parts of the line and for determined curves; pieces struck from various radii being made for the purpose.

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Other materials have been employed for the pipe. Gutta percha was tried as a substitute for leather, but the pipes of this material were found to be liable to splitting. Lately a wrought-iron coated with lead by a new process has been tried, and it is thought may replace the copper. This description of pipe, however, has not yet had a sufficiently long trial to test its merits.

To prevent choking from the entrance of foreign substances, the end of the pipe placed in the cesspool is on the hydraulic system, usually protected by an enlarged piece, about 1 foot long and 9 inches in diameter, made of wrought-iron, and pierced with holes, but on the pneumatic system, where there are no valves in the suction pipe, this contrivance is very rarely used.

The communication between the suction-pipe and the cart being opened by withdrawing, as before described, the plug *b* by means of the forked rod *a* into the recess *c*,—an operation requiring the strength of two men—the matter in the cesspool immediately rushes into the cart, being forced up by the weight of the atmosphere, with considerable velocity to occupy the vacuum existing, which it will do entirely in from two to three minutes. The cart will then be about three-fourths filled with matter, the remaining space being occupied by the rarefied air previously existing in the cart, and by the air contained in the length of suction-pipe. The operation is completed, and the cart entirely filled, by withdrawing this air with a small air pump usually worked by two men. (See Fig. 3.) This is placed upon the ground, and communicates with the cart at top, by a flexible India-rubber tube, about 1 inch in diameter; the air, as fast as it is pumped out, being forced through a similar tube, communicating underneath with the furnace B, where it is burnt. For ascertaining when the cart is full, a piece of glass tube is inserted in the brass end of the air-pipe, through which, by the aid of a small lantern placed near, the matter may be seen to rise.

In case the suction-pipe should become choked, it is cleared by the contrivance shown at G, figure 4. The plug *b* having been thrust back into its place, the piece *d* is unscrewed and turned down; a communication is then opened with the atmosphere through *e* by lifting the valve *f* when its pressure causes the matter contained in the pipe rapidly to descend.

The valve *f* may now be again closed and secured by the piece *d*, the plug *b* again withdrawn, and the operation of filling continued.

When a cart is completely filled, the air-pipe and suction-pipe are detached, and the orifices closed. It is then drawn away, another being immediately brought up to undergo the same process.

In the hydraulic system the suction-pipe used formerly was only $2\frac{1}{6}$ inches ($5\frac{1}{2}$ centimètres) in diameter, but the *Compagnie Richer*, by the use of a peculiar pump, which they have patented, have been enabled to increase theirs to nearly $3\frac{1}{6}$ inches (8 centimètres) in diameter.

The peculiarity of the pump adopted by the Compagnie Richer consists in the use of what may be called leathern lungs to perform the function of the cylinder and pistons in common use; in other respects it is an ordinary double-force pump. By this improvement a considerable amount of friction and consequent labour is saved. These pumps rarely get out

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of order; and they are easily repaired, no very accurate fitting of the parts being required.

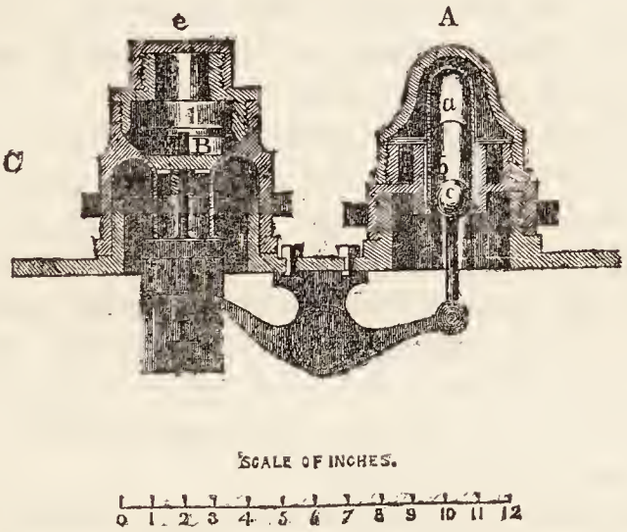
The hydraulic pump is usually worked by four men; it is placed upon the ground at the most convenient spot, and the cart may be filled, under ordinary circumstances, in from three to five minutes.

The furnace consists of a sheet-iron cylinder, about 9 inches in diameter, pierced with small holes, and covered with a conical cap to prevent the flame spreading. The vent-pipe first communicates underneath with a small reservoir, intended to contain the matter in case the operation should be carried too far. A piece is inserted in the bottom of this reservoir, by unscrewing which it may be emptied.

The furnace is sometimes fixed upon a plank, which rests upon two projecting pieces behind the cart.

The indicator sometimes used is represented in Fig. 5. A glass tube *a* (which when not in use is protected by a copper cap) is fixed in the piece *b*; *c* is an indicator fixed on one end of the lever *l*, which rises and falls in this tube; upon the other end of this lever is a cork float, L; when the cart is nearly full, the cork from L rising causes the indicator *c* to descend; this is seen through the glass tube, a small lantern being placed near it.

Fig. 5.



Several contrivances to give the workmen notice of the completion of the operation of filling the cart being near at hand, have been tried. A float rising and stopping the mouth of the air-pipe communicating with the furnace was tried. On the first occasion it answered very well, the pump being suddenly brought to a stand-still. On the second occasion the men continued pumping, although the labour became exceedingly heavy; at last a violent explosion took place; the ends of the cart, with its contents, being forced out and blown to a considerable distance. The noise was so loud that a detachment of men was despatched from the nearest *Corps-de-Garde*, on the supposition that an explosion of gunpowder had taken place. Upon examination it was found, that on the former occasion the float had been pressed so tightly against the orifice of the air-pipe as to prevent its subsequent descent, and consequently no escape of air could take place on the second trial.

Towards the end of the operation, when the quantity of matter remaining in the cesspool, although sufficiently fluid, is too shallow for pumping, it is scooped into a large pail; and the end of the suction-

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pipe being introduced, drawn up into the cart. When the matter is in too solid a state to pass through the pipe, it is carried to the cart in hods, unless it is in considerable quantity. In that case it is removed in vessels called "*tinettes*," in the shape of a truncated cone, holding each about 3½ cubic feet. These vessels are closed with a lid, and are lifted into an open waggon for transport.

The greatest length of suction-pipe that can be worked on the pneumatic system is about 100 mètres; but this will of course vary according to the greater or less depth of the cesspool, and the fluidity of the matter to be pumped. The greatest depth that can be worked with a short length of pipe at the vacuum used is about 26 feet.

On the hydraulic system I am told that practically there is no limit to the length of pipe, and, of course, there is none to the depth. A length of 200 or 300 yards can be worked without greatly increased labour.

The friction through the pipe cannot be regarded as adding much to the labour of pumping when the slowness of the motion is taken into account; at least, supposing the matter to possess a tolerable degree of fluidity, and the machine to be double acting.

The quantity of soil that a gang will remove during the night varies from 18 to 60 cubic mètres, according to the size and depth of the cesspool, the fluidity of the matter, the distance to be gone over, &c. Every gang is expected to perform at least 18 cubic mètres. All done beyond that quantity is paid for extra.

In fixing the rate of charge to the proprietors of houses, Paris has been divided into three districts, by concentric arcs drawn from the *Voirie* of Montfaucon as a centre. In the district nearest to the *Voirie* the charge is 8 francs per cubic mètre; in the others, 9 and 10 francs respectively; this includes every expense, excepting when the deodorizing fluid is used, which it very rarely is; for that an extra charge of 60 centimes, about 6*d*. per cubic mètre, is made. The charge to the proprietors is the same whether the work is performed on the pneumatic or the hydraulic system.

The pneumatic system was introduced only about four or five years since, and the Company Richer went to very considerable expense in carts and machines for carrying it out in a very perfect manner, and upon an extensive scale; conceiving that it offered advantages in permitting the use of a much larger suction-pipe, and the abolition of the valves within it. These advantages, however, have a good deal diminished in value since the adoption of the improved pump for the hydraulic system, which has also permitted an increase in the size of the suction-pipe, and that to an extent more than double its former sectional area.

Independently of the expense of producing the vacuum by steam-power, and which in Paris where coal is dear is by no means inconsiderable, the working expenses of the pneumatic system are nearly if not quite as heavy as those appertaining to the hydraulic system. There is little or no saving in the number of men at the cesspool—a police regulation requiring that there shall never be less than four present in case of accident. And even if such a regulation did not exist, no great saving in this respect could be effected, as a pump requiring the labour of two men, and inconveniently placed near the cart, and as far as possible from the cesspool, has still to be worked at the close of the operation.

Moreover, the carts employed for this system are much more costly than those used for the hydraulic system. Iron has to be substituted for wood for the body, and very accurate workmanship and fitting of every separate piece is required to ensure the certain action of the principle. It is absolutely necessary, too, that the carts should be kept in perfect repair. To guard against the effects of jolting upon rough pavement, they were at first mounted upon springs, which from the heavy weight thrown upon them, were constantly requiring repair. Mr. Rammell.

Taking into account the interest on additional capital sunk in the first cost of the machines, the increased expense of repairs, and some slight increase in the working expenses, it is estimated that the pneumatic system is the more expensive of the two by at least 25 per cent.

Looking at this fact, in connexion with the increased efficiency of the hydraulic system, it is not unreasonable to conclude that the pneumatic system will not long maintain the ground it has gained, but will yield it up again to the hydraulic system which it has to some extent displaced.

Complicated, laborious, and expensive as the operations above described are, it must not be supposed that the process of emptying a fixed cesspool is no longer a nuisance. The magnitude of the original evil is certainly much diminished by the improved method adopted; but in its reduced dimensions it still exists, and will continue to exist as long as the cesspools themselves. On the first removal of the stone that covers the man-hole, there is an escape of gas from the cesspool, and this goes on in greater or smaller volume until this aperture is again closed up; during the pumping the matter oozes from the joints of the pipe if they are not perfectly tight, and from the pipe itself should there be a flaw in any of the lengths: there is an escape of it also on shifting the pipe from one cart to another, and when the several lengths of pipe are disconnected after the operation is completed.

Amongst the means adopted to prevent the vitiation of the atmosphere, is a furnace to burn the noxious gases evolved, and which is not only used for consuming the air drawn from the pneumatic carts at the spot where they are exhausted, but is also conveyed with the carts to every cesspool to be emptied. The advantages attributed to it, however, are very much overrated. When the pump is in full operation, the gases are forced through the furnace with a rapidity too great to allow of perfect combustion; and even supposing the combustion perfect, the resulting gas or smoke evolved and discharged into the atmosphere cannot fail itself to be of an offensive character.

From some or all of these causes there is sufficient gas escaping to vitiate to a greater or less extent the surrounding atmosphere, as I know from experience, having twice, after witnessing these operations, suffered from attacks of illness. On the first occasion the men engaged in the operation omitted to burn the foul air, and the atmosphere being at the time excessively charged with moisture, owing to a heavy fall of rain which had taken place during the evening, so intense was the odour given off, that although the house to which the cesspool belonged was situated in the Rue du Port Mahon, and a perfect calm prevailed, it was most disagreeably perceptible as far off as the Rue Menars, a distance of more than 400 yards. I reached the scene of operation a little after 12 o'clock, and remaining only a few

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minutes, returned home and retired to rest. About 2 o'clock I awoke with a sensation of sickness, and was shortly afterwards taken with violent vomiting and diarrhœa; symptoms which continued at intervals during the greater part of the night, accompanied with alternate fits of shivering and feverish flushing, and also with intense pain across the forehead. In the morning I found my muscular strength completely prostrated, and I did not entirely recover it for a week or ten days afterwards. On the second occasion the attack was much more mild, and unaccompanied by vomiting.

III. Places of Deposit for the Matter withdrawn from the Cesspools.

The present produce of the cesspools of Paris amounts to between 600 and 700 cubic mètres a-day. The principal, and until a few years ago, the only, place of deposit for this matter was the *Voirie* of Montfaucon. M. Jules Garnier, in his "Visite à Montfaucon," says, "For more than nine centuries Montfaucon has been devoted to this purpose. It was there that the inhabitants of Paris were in the habit of depositing their filth before the walls of the capital extended beyond what is now the *Quartier Central*. The distance between Paris and Montfaucon was then more than half a league." At Montfaucon the solid portion of this matter is manufactured into a dry manure, called, from its peculiar appearance, *poudrette*. The basins belong to the *commune* of the city, who have been in the habit of farming them, together with their contents, for periods of nine years, to the highest bidder.

The produce of this sale has increased enormously of late.

	Francs.	Sterling per Annum.
In 1808 the sale was effected for	97,000, or about	£3,880
In 1817 ,, ,,	75,000 ,,	3,000
In 1834 ,, ,,	165,000 ,,	7,000
In 1843 ,, ,,	525,000 ,,	21,000

The proceeds are appropriated by the *commune*.

There appears, however, to be some disposition on the part of the proprietors of the houses to claim a property in the soil after it is deposited at the *Voirie*, and to the proceeds of the sale; and I have been informed that, at the next letting, it is probable they will take measures to try this question of right.

In addition to the manufacture of *poudrette*, a considerable quantity of ammonia is extracted from the liquids, about one-third of the whole being passed through some chemical works for the purpose. The right of extracting the ammonia is farmed at present for 3,200*l.* per annum: this farm-rent belongs to the *Fermier General*.

Voirie of Montfaucon, and Manufacture of Poudrette.—The *Voirie* of Montfaucon is situated to the north of Paris, at a short distance from the Barriers, and not far from the road to Meaux and the basin of La Villette—the feeder of the Canal de l'Ourcq. It is at a considerable elevation above the plain of Paris.

The site of the *Voirie* has undergone extensive excavations for gypsum, or plaster of Paris, and its surface is extremely uneven. The area, which is about 40 acres in extent, is divided into three irregular compartments:—1. The system of basins. 2. The ground used for

spreading and drying the matter. 3. The place where the matter is heaped up after having been dried. Mr. Rammell.

The basins, standing for the most part in gradations, one above another, by reason of the slope of the ground, are six in number. The two upper ones, which are upon a level, first receive the soil upon its arrival at the *Voirie;* the four others are receptacles for the more liquid portion as it gradually flows off from the upper basins.

The ground used for spreading and drying the matter is, in some places, flat; in others, more or less steep: the latter is most favourable for its easy distribution.

There is a great difference in the character of the soil brought; that taken from the upper part of the cesspools, and amounting to a large proportion of the whole, being entirely liquid; while the remainder is more or less solid, according to the depth at which it is taken. The whole, however, during winter or rainy weather, is indiscriminately deposited in the upper basins; but in dry weather, the nearly solid portion is at once thrown upon the drying ground.

It is in the upper basins that the first separation of the liquids and solids takes place; the latter falling to the bottom, and the former gradually flowing off through a sluice into the lower basins. This first separation, however, is by no means complete, a considerable deposit taking place in the lower basins. The mass in the upper basins, after three or four years, then appears like a thick mud, half liquid, half solid; it is of depth varying from 12 to 15 feet. In order entirely to get rid of the liquids, deep channels are now cut across the mass, by which they are drained off, when the deposit soon becomes sufficiently stiff to permit of its being dug out and spread upon the drying-ground, where, to assist the desiccation, it is turned over two or three times a-day by means of a harrow drawn by a horse.

The time necessary for the requisite desiccation varies a good deal, according to the season of the year, the temperature, and the dry or moist state of the atmosphere. Ere yet it is entirely deprived of humidity, the matter is collected into heaps, varying in size usually from 8 to 10 yards high, and from 60 or 80 yards long, by 25 or 30 yards wide. These heaps or mounds generally remain a twelvemonth untouched, sometimes even for two or three years; but as fast as the material is required, they are worked from one of the sides by means of pickaxes, shovels, and rakes; the pieces separated are then easily broken and reduced to powder, foreign substances being carefully excluded. This operation, which is the last the matter undergoes, is performed by women. The *poudrette* then appears like a mould of a grey-black colour, light, greasy to the touch, finely grained, and giving out a particular faint and nauseous odour.

The finer particles of matter carried by the liquids into the lower basins, and there more gradually deposited in combination with a precipitate from the urine, yield a variety of *poudrette*, preferred, by the farmers, for its superior fertilizing properties. In this case the drying process is conducted more slowly and with more difficulty than in the other, but more completely.

In general the *poudrette* is dried with great difficulty; it appears to have an extreme affinity for water; few substances give out moisture more slowly, or absorb it more greedily from the air.

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A good deal of heat is generated in the heaps of dessicated matter. This is always sensible to the touch, and sometimes results in spontaneous combustion.

The intensity of this heat is not in proportion to the elevation of temperature of the atmosphere. It is promoted by moisture. The only means of extinguishing the fire when it is once developed is to turn over the mass from top to bottom, in order to expose it to the air. Water thrown upon it, unless in very large quantities, would only increase its activity.

The quantity of *poudrette* sold in 1818 was—

At the *Voirie*	50,000 *setiers* (4¼ heaped bushels, each English measure.)
Sent into the departments .	20,000 *setiers*.
Total sale, 1818 . . .	70,000 *setiers*, at prices of 7, 8, 9 francs the *setier*.

This is equal, at the average price of 8 francs, to 22,400*l*. sterling.

The refuse liquids, as fast as they overflow the basins, or are passed through the chemical works, are conducted into the public sewers, and through them into the Seine, nearly opposite the Jardin des Plantes. They thus fall into the river at the very commencement of its course through Paris, and pollute its waters before they have reached the various works lower down, and near the centre of the city, where they are raised and distributed for household purposes, for the supply of baths, and for the public fountains.

Before quitting Montfaucon and its products, I may mention that a plot of ground adjoining the *Voirie* is set apart as a slaughtering-ground for horses, and as a place of deposit for the carcasses of all those dying in Paris. The late M. Parent du Chatelet, to whose Reports I am indebted for many of the preceding particulars, says, "According to the report of the women who skin them, it appears that the number of these carcasses is considerable, since they have sometimes received as many as 500 a-week. This, however, must probably be looked upon as an exceptional case, as in the numerous journeys I have made to the *Voirie*, I have never counted more than 15 or 20 taken in in the course of the day."

"The unburied carcasses of these animals would undoubtedly produce disease, were it not that, before decomposition can take place, they are devoured entirely by rats. These animals are found by thousands in this place, and their voracity is such, that I have often known them, during a single night, convert into skeletons the carcasses of 20 horses which had been brought the evening before. The bones are burnt to heat the coppers, or to get rid of them."

Speaking of the disgusting practices at the *Voirie*, Mr. Gisquet says, "I have seen men stark naked, passing entire days in the midst of the basins seeking for any objects of value they might contain. I have seen others fishing for the rotten fish the market inspectors had caused to be thrown into the basins. Two cartloads of spoilt and stinking mackerel were thrown into the largest of the basins; two hours afterwards all the fish had disappeared."

The emanations from the *Voirie* are, as may well be supposed, most

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powerfully offensive. To a stranger unaccustomed to the atmosphere surrounding them, it would be almost impossible to make the tour of the basins without being more or less affected with a disposition to nausea. Large and numerous bubbles of gas are seen constantly and rapidly rising from a lake of urine and water, while evaporation of the most foul description is going on from many acres of surrounding ground upon which the solid matter is spread out to dry. Such is the state of fermentation of the liquids in the basins that their temperature is said to be considerably elevated.

In perfectly calm weather these disgusting exhalations spread over a wide area around the *Voirie*. From habit the inhabitants of the neighbourhood may disregard them, but the stranger coming from Paris will perceive a disagreeable odour before or immediately after he has passed the Barrier. A fresh breeze will carry them over a distance of many miles, and when blowing from a northerly direction, the foul volume is swept by it entirely across Paris. Under peculiar states of the atmosphere its presence may be distinguished at the opposite extremity of the city; in the centre, and particularly along the quays, it is at such times most disgustingly apparent; while on the Boulevards, Bonne Nouvelle, St. Martin du Temple, &c., it prevails in intolerable strength; there it penetrates everywhere, pervading the cafés, the theatres, and the houses.

M. Parent du Chatelet thus describes the gigantic nuisance in a report to the Council of Health, written in 1833:—

"The influences of this *Voirie* have necessarily increased with the quantity of matter which has been deposited there. At the present time the infectious emanations given out from it are insupportable at all seasons within a circumference of 2,000 mètres (about $1\frac{1}{4}$ miles); and the winds carry them sometimes with all their intensity to a distance of 4,000 mètres, and evidence collected by the Commission charged to ascertain the extent of the ravages of the cholera in the rural communes, shows that certain states of the atmosphere, rarely occurring it is true, propagate them even to a distance of eight French miles (nearly five English miles). Can it be otherwise while the superficial area of the basins alone is 32,800 mètres (39,228 square yards), without including 12 acres occupied by the dry matter and the knackers' yard; and while from 230 to 240 cubic mètres of matter withdrawn from the cesspools are daily deposited there, and the larger part of the carcasses of 12,000 horses, and of from 25,000 to 30,000 small animals are allowed to rot upon the ground."

New Voirie at Bondy.—The nuisance was found to be so excessive, and people exclaimed so loudly against it, that the *Commune* of Paris determined many years since to remove the *Voirie* altogether away from the vicinity of the city. With this view they caused another place of deposit to be formed in the Forest of Bondy, about eight miles distant from Paris. This consists of eight basins, placed in two sets of four each on either side of the Canal de l'Ourcq, and each set arranged, like those of Montfaucon, one above the other in the manner of steps, so that the liquids may fall from the upper to the lower basins. The total area of these basins is 95,680 square yards (80,000 square mètres), and their collective capacity 261,385 cubic yards (200,000 cubic mètres).

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For reasons, however, which will appear presently, the intention with which this new *Voirie* was established, namely, as a substitute for that of Montfaucon, has been but partially realized. The contents of the moveable cesspools only, averaging a little over 30,000 cubic mètres annually, have been hitherto deposited in it. The moveable cesspools are first taken to a wharf on the Canal de l'Ourcq at Pantin, where they are placed on board a boat for conveyance to the basins. The empty casks are brought back by the same channel.

The quantity of matter yet sent has not been sufficient to fill the basins; there has been no necessity for draining off any excess of liquid. Should, however, the entire produce of the cesspools of Paris be ultimately sent thither, the daily addition would speedily fill the basins. It is then intended to get rid of the surplus liquids by discharging them through a pipe into the Seine, near St. Denis.

The truth, however, appears to be that the establishment of these basins in the Forest of Bondy was undertaken without any very definite notions as to the mode by which the fæcal matter was to be conveyed to them. The Canal de l'Ourcq offered a ready though costly means of transport during the greater part of the year, but in winter communication by this channel is liable to be entirely closed by frost. In 1834, about 20,000 cubic mètres were sent by canal to Bondy at a cost to the administration of 36,000 francs (1,440*l.* sterling).

Amongst other plans for obviating this acknowledged difficulty, a railway along the bank of the canal was projected, as presenting a channel of communication open with certainty at all seasons; but the idea was abandoned, I believe, chiefly on the ground of expense.

M. Mary, the able engineer to the city of Paris, proposed another plan for the conveyance of the matter to Bondy, which after having undergone a good deal of discussion, has been adopted by the administration. His plan has two features almost distinct: it provides, in the first place, depositing tanks, adjoining the Canal de l'Ourcq, at Pantin. These tanks are 27 in number, and are arranged in 3 parallel sets of 9 each. They are constructed in masonry and arched over, their upper surface being level with the ground, and they all communicate with one common exit pipe. Their collective capacity is 3,134 cubic yards (2,400 cubic mètres). Each tank is provided with an apparatus which, after the solid portion of the matter discharged into it has deposited itself, permits the fluid to be drawn or strained off;—

The set of depositing tanks communicate by means of a pipe $10\frac{5}{8}$th inches (27 centimètres) in diameter, and about 6 miles long, with the basins at Bondy. The pipe is made of rolled galvinized iron, about $\frac{1}{16}$th of an inch thick, covered externally with bitumen and lined with pitch. It is laid on an inclination upwards from the tanks to the basins.

M. Mary proposes, first, to discharge the matter extracted from the cesspools into the tanks, where it is to be allowed time for deposit; and when the solid portion shall have fallen to the bottom, the fluid is to be drawn off and forced by steam power, (a 25-horse engine having been erected for the purpose,) through the pipe into the basins at Bondy. The half-solid mass remaining is then to be raised from the tanks, by hand-pumps or other means, into casks, each containing two cubic mètres, and conveyed to the basins, as hitherto, by canal.

As far as I could learn, this plan has not been adopted on the suppo-

sition that any large portion of solid matter can be sent in suspension in the fluid through the pipe into the basins at Bondy; the anticipations on this point appear to be very moderate. Still, with matter of an average consistency, as before stated, of one of solid to four of liquid, it is pretty certain that (without dilution) the whole quantity cannot be thus disposed of. The plan, then, in its present form does not entirely obviate the objection before mentioned, as appertaining to conveyance by canal; the transit of the matter in winter being still liable to be stopped by frost. Under these arrangements, apprehension of the inconvenience which would result from such an occurrence will hardly yet permit the abolition of the *Voirie* of Montfaucon. Mr. Rammell.

IV. Concluding Observations.—Inconveniences of the Present System, and Projects for their Remedy.

Increase of Matter in the Cesspools, and proposed Mode of dealing with it.—The rapid increase of the quantity of matter in the cesspools, with the proportionately increasing expense of extracting and removing it, has long engaged the serious attention of the authorities, and many experiments have been made with a view to arriving at some plan for arresting or reducing the evil. Although none of these experiments have as yet realized any adequate practical result, it might be interesting to give a few particulars of them, in order to give a truer idea of the magnitude of a now admitted evil, and of the difficulty of framing any amendment upon a faulty principle which shall not lead to other evils almost as intolerable as that it was intended to avoid. The whole of these experiments and projects tend to show that half measures of cleanliness are almost worse than useless; and that efficient drainage and water supply must necessarily go hand in hand.

The following figures will show the increase that has taken place from 1810 to the present time:—

	Cubic Mètres.
In 1810 the total quantity of matter deposited in the basins at Montfaucon amounted to . . .	50,151
In 1811 the quantity was	49,545
In 1812	49,235
Giving an average for the three years of .	49,877
The quantity, as before stated, at present conveyed to Montfaucon and Bondy amounts, according to M. Heloin (a very good authority), to from 600 to 700 cubic mètres daily, giving, in round numbers, an annual quantity of	230,000,

and showing an increase in 36 years of very nearly four hundred per cent.

In 1835 the Prefect of Police and the Prefect of the Seine, called together a Commission to consider this subject in connexion with the removal of the *Voirie* of Montfaucon. In a Report drawn up by certain members of the Commission, MM. Labarraque, Chevalier and Parent du Chatelet, the principal causes of this increase are stated to be:—

1. The improvements introduced in the construction of cesspools by which all leakage into the sheet of water beneath the ground, which prevailed almost universally before, is prevented.

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2. The more common use of water-closets, constructed after the English principle, which require water to keep them clear, and the greater quantity of water at command by reason of the pipes of the Canal de l'Ourcq.

3. The increased use of baths in private houses, in consequence of the more moderate price at which they are supplied.

The Report states,—

"The expense of emptying the cesspools has increased for some years past in a remarkable manner, and everything proves that it will increase more and more without its being possible to assign a limit where it will stop.

"In large mansions, where numerous servants are kept, we find already foreshadowed the future state of the cesspools generally. It is not at present as formerly, every four or five years that the cesspools of these houses are emptied, now the operation is performed two or three times in the course of a single year, and in some of them the liquids form nine-tenths of the matter extracted."

And further, referring to its effect upon the water supply:—"This city now possesses an immense mass of water which she might, in a short time, distribute throughout every quarter and in every house. The works necessary for this distribution are upon an admirable scale, but do people apply to have the water laid on to their houses in proportion as the pipes are extended? Certainly not, and one may well be surprised at the apparent indifference and apathy shown by the landlords in this respect. Some persons take advantage of this circumstance to prove that seven litres ($6\frac{1}{6}$ quarts nearly) of water are sufficient for the daily consumption of the inhabitants of Paris, while sixty litres are found necessary in London and more still in Edinburgh. But if we examine more closely this indifference of the landlords, we shall perceive that it is the result of prudence, and that it proceeds from strictly accurate calculation. The landlords, in fact, regard their cesspools with consternation; the idea of an approaching *vidange*, terrifies them. This operation, and the expense that it occasions, often influence the money value of house property. Is it likely then that in this disposition of mind they should be induced to subscribe to the water-works, when the inevitable result will be to increase the number of the operations which they most dread, and to augment their expenses in an enormous proportion? Thus, the actual state of our cesspools, and the mode of emptying them now in use, are in our view of the case the principal causes which hinder private person from laying on water to their houses, and which delay the period when the city may receive the interest for the enormous sums which it has devoted, and continues daily to devote, to obtain and complete a system of water supply."

In fine, the Commission seems to have been very fully impressed with the absolute necessity of disposing of the liquid part of the matter found in the cesspools by some less expensive method than that of transport to Montfaucon or Bondy.

After certain experiments it appears they arrive at the conclusion, "that 50 parts of water are sufficient, being mixed with it, to destroy the taste of one part of the liquids found in the apparatus of a moveable cesspool, and that 100 parts are sufficient to cause the smell totally to disappear," and they state their opinion that these liquids, mixed with

four or five times their quantity of water, might be discharged into the open gutters of the public streets with less offensive effect than the household waters, and those of a great number of manufactories which now flow upon it. Mr. Rammell.

And after weighing the respective advantages offered by the various inventions for separating the solid portion of these matters from the liquid, the Commission recommend, that when a proprietor should have caused the water of the Canal de l'Ourcq to be laid on to his house, he should have permission accorded him so to discharge into the public street the liquid contents of his cesspool, separated from the solid by a straining apparatus, the proprietor taking care to mix with them a sufficient quantity of water to neutralize their disagreeable qualities.

In considering this recommendation, it must be remembered that the principal streets of Paris only are provided with sewers, and that in many cases these liquids would have to flow over several hundred feet of shallow gutter before arriving at the nearest gully. The effect of carrying it out may then be conceived. Every house pouring fourth its stream of diluted privy liquid, to spread and evaporate over so vast a surface. Notwithstanding the opinion of the Commissioners, one may safely assert, that no practicable addition of water could smother the offensive gases, or prevent their escape into the atmosphere. The evil therefore would not be destroyed, but merely disguised.

With regard to the disposal of the solid matters, the Commissioners recommend the adoption of a process of disinfection, which should render its manufacture into *poudrette* less offensive and insalubrious, and upon the realization of this project they further recommend the complete suppression of the existing *Voirie*.

The disinfecting property of carbon has long been acknowledged :— and it appears that some years ago M. Salmon made some experiments upon a mass of mud, being the deposit from a sewer on the banks of the Seine, which containing a considerable quantity of organic matter he carbonized. " A factory was soon established to carry on further operations of the kind, and for four years past large quantities of night-soil, collected in all the villages round Paris and in Paris itself, have been dried and disinfected in this manner."

The report of the above-named Commission states :—" The discovery of M. Salmon awakened the attention of the contractors of Montfaucon, who employed one of our most skilful chemists to find for them a means of disinfection other than that for which M. Salmon had taken out a patent. M. Sanson and some other persons made similar researches, and from their joint investigations it resulted that disinfection might be equally well produced with turf ashes, with carbonized turf, and with the simple ' debris' of this very abundant substance ; and that the same success might be obtained with sawdust, with the refuse matter of the tan-yards, with garden mould, so abundant in the envirous of Paris, and with many other substances. A curious experiment has even shown that after mixing with a clayey earth a portion of fæcal matter, it was only necessary to carbonize this mixture to obtain a perfect disinfectant powder. Theory had already indicated this result, for what is fæcal matter but a compound of vegetable and animal matters?"

In short it was found that the disinfection of the fæcal matter of cesspools had already been carried on to a considerable extent by the above-

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cited process, and the commission of 1835 recommended the still further application of the principle. The Report states:—

"The first thing to be done, should be to obtain a modification of the manner in which the manufactories of *poudrette* are classified. In the first class should be placed those manufactories working by the methods in common use, and in the second class those which employ less offensive means.

"This modification obtained, the administration might declare that the working and the preparation of the matters, the produce of the cesspools by means not insalubrious, re-entered in the domain of public industry, and that any one would be free to take to it, upon conforming to the regulations which it might be thought proper to impose, according to the particular conditions of each locality.

"The inevitable result of this declaration would be the creation in the environs of Paris of 10, 15, or 20 spots destined to these sort of preparations, an inestimable advantage, not only as regards the economy of transport, but even in a greater degree as respects the public health; for even supposing that which appears to us impossible, that some bad smells emanated from these establishments, they would always be in such small volume that they would hardly pass beyond the gates.

In another report by M. Parent du Chatelet, he thus describes the particular process of disinfection:—

"Before the Commissioners, MM. Salmon, Payen, and Company, caused two pails full of the liquid matters of the cesspools to be poured into a vessel; they threw upon these matters an absorbent carbonized powder, and in the space of two minutes, watch in hand, the disinfection was so complete that the Commissioners could take handfulls of this new substance, place it to the nose, and only distinguish a slight ammoniacal smell, fresh, and without the least trace of animal matter. So prompt and complete was the operation, even the hands of the workman who had mixed and stirred the composition were free from smell.

"The Commissioners caused the experiments to be repeated upon a whole tub full of fæcal matter, and in the space of five minutes the results were as satisfactory as in the experiment on the small scale."

"So powerful is the disinfectant property of this substance, that it will destroy the stench arising from putrid entrails as easily as that given off by fæcal matters. The Commissioners have witnessed this on several occasions with much surprise."

M. Paulet states:—

"The excretions are, by these means, so perfectly disinfected, that M. Darcet placed some of the powder resulting from the process in a China saucer, and caused it to be handed about one evening in his salon in the midst of a numerous society, giving it out for a certain mineral. Great was the surprise of his guests when he informed them afterwards what was the real nature of the pretended mineral."

The Commissioners are completely silent upon so important a point as the cost of carrying out the new system they propose, which there can be no doubt from the large proportion of the carbonised material requisite to produce complete disinfection, would, in transport alone, be very considerable.

Notwithstanding all their investigations, experiments, and strong recommendations, the new project has been carried out to a very limited

extent. The last of these reports was written so far back as 1835, and the great bulk of the solid produce of the cesspools of Paris contained within the barriers is still conveyed to Montfaucon as described in a former part of this paper, where it is manufactured into *poudrette* in the manner practised at that time, and which had been practised for ages before. Mr. Rammell.

Expense of the Cesspool System compared with that of Tubular Drainage.—I shall now endeavour to calculate the cost of the cesspool system, as carried out in Paris, and the annual expense of it, per head of population. I shall then compare the expense of this system with the estimated expense of a system of tubular drainage; and afterwards very cursorily consider the advantages, in an economical point of view, of substituting, in Paris, the latter system of drainage for the cesspool system at present in operation.

The first point to determine, in making these calculations, is the actual cost of the working of the present cesspool system in Paris.

The daily quantity of matter at present withdrawn from the cesspools is, as before stated, between 600 and 700 cubic mètres; giving, in round numbers, the annual quantity of 230,000 cubic mètres. The average charge per cubic mètre for extraction and transport is 9 francs, giving a gross annual charge of 2,070,000 francs (82,800*l.* sterling), which sum, it would appear, is paid every year by the house-proprietors of Paris for the extraction of the matter from their cesspools, and its transport to the *Voirie*.

Dividing this annual quantity of 230,000 cubic mètres by the number of the population of Paris (945,721 individuals according to the last census), we have 243 litres only as the annual produce from each individual. The daily quantity of matter (including water) passing from each person into the cesspool has been before stated to be $1\frac{3}{4}$ litres (3·08 pints), or 638 litres annually. The discrepancy between these two quantities, wide as it is, must be accounted for by the fact of a large proportion of the lower orders in Paris rarely or ever using any privy at all, and by allowing for the small quantity of water made use of in the privies of the inferior class of houses. There can be no doubt that this latter quantity of $1\frac{3}{4}$ litres daily is very nearly correct, and not above the average in houses where a moderate degree of cleanliness is observed. This proportion was ascertained to hold in the case of some barracks in Paris, where the contents of the cesspools were accurately measured, the total quantity divided by the number of men occupying the barracks, and the quotient by the number of days since the cesspools had been last emptied; the result showing a daily quantity of $1\frac{3}{4}$ litres from each individual. The correctness of this estimate too has been confirmed, as M. Heloin assured me, by the experience of the Compagnie Richer in the case of private houses.

The average cost of construction of each cesspool, it has been already stated, cannot be estimated at less than 18*l.* sterling. It is common, however, in Paris for a single house to have two or three cesspools, placed to suit local convenience, in different parts of the premises. Supposing the average to each house not to exceed one and a-half, and the cost of each cesspool to be 18*l.* sterling, we shall have a capital of 27*l.* sterling per house sunk in works of construction of

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cesspools. The average number of inmates per house in Paris is 24 persons.

Adopting these calculations of the number of cesspools to each house and their cost, and allowing only the small quantity of $1\frac{3}{4}$ litres (3·08 pints) of matter to each individual, the annual expense of the cesspool system in Paris per house containing 24 persons will be: for interest, at five per cent. upon capital sunk in works of construction, 1*l.* 7*s.*; for extraction and removal of matter, 5*l.* 11*s.*; total, 6*l.* 18*s.*; the annual expense per inhabitant will be 5*s.* 9*d.*

This latter, then, may be taken as the average yearly sum per head actually paid by that portion of the inhabitants of Paris who use the cesspools. We will now turn to consider the estimated cost of the system of tubular drainage applied to a middle class house in London.

Upon the basis of the estimates given in the First Report of the Metropolitan Sanitary Commissioners, the cost for works of construction of a tubular system of refuse drainage may be set down at the rate of 4*l.* 3*s.* per house of eight inhabitants. This estimate includes not only the house-drains, but also a fair share of the public sewers necessary for the conveyance of the refuse matter away from the habitation, to a distant outfall, and is intended to represent the whole cost of the system, to an ordinary middle class house, containing eight inhabitants. The total annual cost of the system then will be comprised in the interest upon capital sunk in works, which, at 5 per cent., will amount to 4*s.* 2*d.* per house, or $6\frac{1}{4}$*d.* per inhabitant, being less than one-tenth part of the charge per inhabitant entailed by the cesspool system according to the preceding calculation. It should be observed, however, that in the case of houses situated in low districts, where, in order to effect the discharge of the refuse at a sufficient distance from the site of the city, it would be necessary to pump it up by engine-power, an additional charge, amply covered by a rough estimate of 2*s.* per house, must be reckoned upon. But even allowing the extra charge for pumping, a very considerable pecuniary balance, amounting to several hundreds per cent. would be found to be due to the tubular over the cesspool system.

In order to test the accuracy of these estimates I will now refer to evidence recently given before the Board of Health, by three of the officers of the Metropolitan Commissioners of Sewers, who may be supposed to have had the greatest practical experience on the subject.

Mr. Lovick, the Surveyor for the Westminster District, gives the case of a block of nearly 1,200 houses, of "a medium middle class," in and near Earl-street, and he estimates the entire cost, public and private, of a system of tubular drainage, including water-closet pan, &c., at about 4*l.* 8*s.* per house.

Mr. Grant, the Surveyor for the Surrey and Kent District, states, in the case of a block of 44 houses, of about 15*l.* rental, the estimated cost of tubular drainage, exclusive of pans, traps, &c., at 1*l.* 18*s.* per house; in another case of a block of 23 houses, at 1*l.* 19*s.* 8*d.* per house; in another block of 46 houses, at 1*l.* 8*s.* $9\frac{3}{4}$*d.* per house; and in a fourth block of 46 houses, at 1*l.* 8*s.* $10\frac{1}{2}$*d.* per house.

Mr. Gotto, Surveyor for the Holborn District, in the case of a block of houses of the inferior class, covering an area of about 9 acres, and situate in Goulstone-street, Whitechapel, estimates the whole cost of

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private drainage, including the fitting up of existing cesspools, water-closet with stool cock, and kitchen and yard sinks complete, at 3*l.* 2*s.* 9½*d.* per house; and the proportion of the expense of main sewers at 1*l.* 9*s.* 6*d.* per house; making a total of 4*l.* 11*s.* 9*d.* per house. Exclusive of the cost of filling up the cesspools, however, the cost per house would be for private drainage, 1*l.* 9*s.* 7½*d.* per house, which, added to the proportion of expense of public sewers, (1*l.* 9*s.*) would give 2*l.* 18*s.* 7½*d.* per house, as the whole expense of a system of tubular drainage.

These cases, coming from the quarters they do, will I think be sufficiently corroborative of the liberality of the estimate upon which I have argued in a preceding paragraph, of 4*l.* 3*s.* 6*d.* per house of an ordinary class, for the laying down of a system of tubular drainage.

Even this, however, does not represent the full difference in the expense of the two systems. The cesspool does not receive the water that has been used for cleansing and culinary purposes, nor the surface water of the streets and houses, and sewers and drains have still to be provided to convey away this portion of the liquid refuse. While with the tubular system of refuse drainage, the same channels that carry away the fæcal matter from the houses are open to receive the fluids derived from the other sources that have been mentioned, and one outlay, one system of pipes, one staff of superintendents, will serve for the accomplishment of both objects.

Let us now see whether the tubular system of drainage, the abstract superiority of which I will suppose to be admitted, might not even at this time be applied to Paris, not only without inflicting any increased charge upon the inhabitants, but even with a positive saving to them of a considerable portion of their current outlay for the extraction and removal of the contents of their cesspools. For this is the only point of view in which the comparison may be instituted with any chance of a practical result, in the case of a town already fully provided with a system of cesspools, however vicious and inconvenient that system may have been shown to be. The outlay upon works of construction having already been undertaken and liquidated, it would not be a sufficient inducement to the people of Paris to adopt a new system, to tell them that their money has been badly expended, and that, for a less sum, they might now construct a tubular system of drainage, which would render their cesspools unnecessary for the future. In advocating a change of system to practical men, we must start from the point at which we stand, and it is of importance to show that the absolute current expenses attaching to the existing system, might be made sufficient for the substitution of all works of construction necessary for the improved system, as well as all annual charges for the working of it; and if in addition it can be shown that a balance will then absolutely remain in hand at the end of each year to be carried to the credit of the new system, we offer an amount of inducement, both in increased cleanliness and comfort, and in pecuniary gain, which few rational men would refuse to listen to.

I propose now to show (adopting a very rough estimate), that it would be perfectly feasible to establish a system of tubular drainage in Paris, by the economical use of an annual income, much under the

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amount at present expended by the inhabitants in the extraction and removal of the contents of their cesspools.

The annual amount so expended in Paris is, in round numbers, over 82,000*l.*

In forming an estimate of the probable cost of laying down a tubular system of drainage in Paris, as founded upon the foregoing estimates, it might be proper to bear in mind a fact already incidentally referred to, viz., that as the houses in Paris are much loftier than those in London, and the average number of inhabitants to each much greater, the average extent of mileage of any sewers or drains to be laid down for their use would be proportionably less per head. Accordingly, we find that the area of Paris is only about one-fourth that of London; or, in proportion to population, one-half. The force of this position would appear to be so obvious that it seems necessary to do no more than make a very casual reference to it, the more particularly, as in the general calculations I am about to make, I do not intend to take advantage of it for the purpose of reducing the estimate of cost of the application of the proposed system.

I shall assume then, the cost for works of construction in Paris, where the houses average 24 inhabitants each, to be after the same rate per head as in London, where the houses do not average 8 inhabitants each; namely, about 10*s.* 6*d.* per head, or 12*l.* 12*s.* per house. This, for a population of a million, in round numbers, would give a gross outlay for works of construction of a system of tubular drainage of 525,000*l.*; or, including a long length of outfall pipe, say of 600,000*l.*; the annual interest of which, at 5 per cent. would be 30,000*l.* Supposing that in the case of one-third of Paris, engine power would be required for the purpose of pumping the refuse, an additional sum of 5,000*l.** (which experience would show to be more than ample) may be allowed for it. Adding to this 5,000*l.* for charges of management, the whole annual expense of removing, by means of a system of tubular drainage, the refuse of Paris beyond the boundaries of the city to a spot where its accumulation would not create a nuisance, would be 40,000*l.*, which, being deducted from 82,800*l.*, the actual cost of the working of the present cesspool system (apart from the cost of works of construction) would leave a clear balance or saving of more than 42,000*l.* a-year.

The above calculation is founded upon the present cost of the working of the cesspool system in Paris. It should be borne in mind, however, that of late years this cost has been constantly on the increase (to the extent of nearly 400 per cent. in the last 36 years), and that there is every probability of its still increasing, without any assignable limit. In this view of the case, the saving to be affected by a timely application of the tubular system becomes proportionably more important. As an additional circumstance tending to favour the adoption of a tubular system of refuse drainage in Paris, it should be borne in

* I suggest this item of expenditure merely to be on the safe side; though, from a general observation of the site of Paris, I think it more than probable that the drainage of even the lowest parts of the city might be discharged at a point down the valley of the Seine, sufficiently remote for sanitary purposes, by natural means only. Paris has this advantage over London, that it is placed above the influence of the tide.

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mind that most of the houses are already provided with pans upon nearly every floor, and with the pipes necessary for conducting the matter below the basement; the only private works remaining to be effected, supposing the public works to have been completed, would be to divert the point of discharge of these tubes from the existing cesspools to the main arteries of the system of drainage so laid down in the streets. The refuse would thus on the instant of production be put in course of conveyance to a distance from the town, at the rate of probably about 3 miles per hour, instead of stagnating and fermenting as at present for months together, until removed by a complicated, laborious, costly and offensive process.

Conclusions.—From the facts detailed in the above description of the cesspool system of Paris, we may conclude,—

1. That this system, to be well carried out, requires, both in its works of construction and in those of extraction and transport of the fæcal matter; most comprehensive and detailed regulations, involving wide-extended supervision, and constant, minute, and difficult inspection, to ensure their observance.
2. That with the most perfect regulations and supervision, and the application to the purpose of machines constructed upon scientific principles, the operation of emptying a cesspool is still a nuisance, not only to the inmates of the house to which it belongs, but to those of the neighbouring houses, and to persons passing in the street; and that a place of deposit being necessary for the matter extracted, the system unavoidably entails a wide-spreading and most disgusting public nuisance upon some point or other of the environs of the city where it is adopted.
3. That the cesspool system presents an obstacle to the proper extension of the water supply, and consequently represses the growth of habits of personal and domestic cleanliness, with their immense moral results; and that in this respect it may be said to be inconsistent with a high degree of civilization of the masses of any community.
4. That, compared with a tubular system of refuse drainage, it is an exceedingly expensive mode of disposing of the fæcal refuse of a town, so much so, that even in Paris the existing cesspools might be abandoned, and a system of tubular drainage substituted, for a considerably less annual sum, including interest for capital sunk in works of construction, than is now spent in emptying the cesspools; whilst viewed in connexion with the whole subject of town drainage, it is seen to involve an expense at once serious and altogether useless and unnecessary.

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APPENDIX.

NOTE ON THE USE OF "POUDRETTE."

In connection with this subject, a few observations upon the application of *poudrette* in agricultural processes may not be without interest.

With regard to the fertilizing properties of this preparation, M. Maxime Paulet, in his work entitled "Theorie et Pratique des Engrais," gives a table of the fertilizing qualities of various descriptions of manure, the value of each being determined by the quantity of nitrogen it contains. Taking for a standard good farm-yard dung, which contains on an average 4 per 1,000 of nitrogen, and assuming that 10,000 kilogrammes (22,046 lbs. English) of this manure (containing 40 kilogrammes of nitrogen) are necessary to manure one hectare ($2\frac{1}{2}$ acres nearly) of land, the quantities of *poudrette* and of some other animal manures required to produce a similar effect would be as follows:—

			Kilogrammes.
Good farm-yard dung, the quantity usually spread upon one hectare of land			10,000
Equivalent quantities of human urine, not having undergone fermentation			5,600
,,	,,	*poudrette* of Montfaucon	2,550
,,	,,	mixed human excrements (this quantity I have calculated from data given in the same work)	1,333
,,	,,	liquid blood of the abattoirs	1,333
,,	,,	bones	650
,,	,,	average of guano (two specimens are given)	512
,,	,,	urine of the public urinals in fermentation and incompletely dried	233

Mr. Paulet estimates the loss of the ammoniacal products contained in the fæcal matters when they are withdrawn from the cesspools, by the time they have been ultimately reduced into poudrette at from 80 to 90 per cent.

I have not been able to meet with an analysis of the matters found in the fixed and moveable cesspools of Paris, but in the "Cours d'Agriculture," of M. le Comte de Gasparin, I find an analysis by MM. Payen and Boussingault of some matter taken from the cesspools of Lille, and in the state in which it is ordinarily used in the suburbs of that city as manure. This matter was found to contain on the average 0·205 per cent. of nitrogen, and thus by the rule observed in drawing up the above table, 19·512 kilogrammes of it would be necessary to produce the same effect upon one hectare of land as the other manures there mentioned. The wide difference between this quantity and that (1,333 kilogrammes) stated for the mixed human excrements in their undiluted state, would lead to the conclusion that a very large proportion of water was present in the matter sent from Lille, unless we are to attribute a portion of the difference to the accidental circumstance of the bad quality of this matter. It appears that this is very variable, according to the style of living of the persons producing it. "Upon this subject," M. Paulet says, "the case of an agriculturist in the neighbourhood of Paris is cited, who bought the contents of the cesspools of one of the fashionable *restaurants* of the 'Palais Royal.' Making a profitable speculation of it, he purchased the matter of the cesspools of several barracks. This bargain, however, resulted in a loss, for the produce from this last matter came very short of that given by the first."

Poudrette weighs 70 kilogrammes the hectolitre (154 lbs. per 22 gallons), and the quantity usually spread upon one hectare of land ($2\frac{1}{2}$ acres nearly) is 1,750 kilogrammes, being at the rate of about 1,540 lbs. per acre English measure. It is cast upon the land by the hand, in the manner that corn is sown.

M. de Gasparin says, "Poudrette gives great activity to vegetation, but its effects are soon exhausted, and it is thought that sometimes they are not prolonged even to the period of fructification of farinaceous plants. It promotes great vigour in herbage, but it is said to communicate a flavour to it which is distasteful to cattle. It is for this

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reason also that gardeners refuse to employ manures of this class, which emit in a short space of time large quantities of ammoniacal vapours to be absorbed and retained by the leaves." *Poudrette* is not applied to the market gardens or in agriculture in the immediate vicinity of Paris, nor within a circle of four or five leagues around it. Besides the reason stated by M. de Gasparin as inducing gardeners to reject it, it is of too heating a nature to suit the light, dry, calcareous soil of this district—and even if its qualities accorded well with the soil, it could not be supplied at a price to enable it to compete with the stable manure furnished in such enormous quantities by the city, in addition to its other refuse which is valuable as manure. I am informed that the cold clay soils derive much advantage from poudrette.

Poudrette packed in sacks very soon destroys them. This is always the case, whether it is old or has been newly prepared.

A serious accident occurred in 1818, on board a vessel named the "Arthur," which sailed from Rouen with a cargo of *poudrette* for Guadaloupe. During the voyage a disease broke out on board which carried off half the crew, and left the remainder in a deplorable state of health when they reached their destination. It attacked also the men who landed the cargo; they all suffered in a greater or less degree. The poudrette was proved to have been shipped during a wet season, and to have been exposed before and during shipment in a manner to allow it to absorb a considerable quantity of moisture. The accident appears to have been due to the subsequent fermentation of the mass in the hold—increased to an intense degree by the moisture it had acquired, and by the heat of a tropical climate.

M. Parent du Chatelet, to whom the matter was referred, recommended that, to guard against similar accidents in future, the poudrette intended for exportation, in order to deprive it entirely of humidity, should be mixed with an absorbent powder, such as quick lime, and that it should be packed in casks to protect it from moisture during the voyage.

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